

CHAPTER 2 AIR EMISSIONS

C2.1 SCOPE

This chapter contains the Final Governing Standards (FGS) for the control of air emissions from Department of Defense (DoD) owned and/or operated facilities and equipment in the Federal Republic of Germany.

C2.2 DEFINITIONS

Administrative prescriptions. Supplemental requirements issued to a specific facility by the responsible administration (e.g., regulatory agency, municipal authority).

Chlorofluorocarbons (CFCs). Compounds consisting of chlorine, fluorine, and carbon atoms which are very stable in the troposphere. They are degraded only in stratosphere by the sun's radiation where released chlorine may contribute to ozone depletion.

Coal Refuse. Waste products of coal mining, cleanings and coal preparation operations (e.g., culm, gob, etc.) containing coal, matrix material, clay, and other organic and inorganic material.

Cold Cleaning Machine. Any device or piece of equipment that contains and/or uses liquid solvent, into which parts are placed to remove soils and other contaminants from the surfaces of the parts or to dry the parts. Cleaning machines that contain and use heated, nonboiling solvent to clean the parts are classified as cold cleaning machines.

DIN. *Deutsches Institut für Normung, e.V.* German Institute for Standardization, registered association.

Emissions. Emissions are air pollution (dust, smoke, gases, aerosols, steams, or odors), noise, shocks, light, warmth, radiation, and similar effects produced by facilities or activities. Emissions will be described as:

- mass concentration in grams per cubic meter (g/m³) or milligrams per cubic meter (mg/m³) related to waste gas in normal condition (0° C; 1013 mbar with or without humidity content and steam water);
- mass flow of emitted substances in kilograms per hour (kg/hr), grams per hour (g/hr), or milligrams per hour (mg/hr); or
- mass of emitted substances in relation to products in kilograms per ton (kg/t) or grams per ton (g/t).

Fossil Fuel. Natural gas, petroleum, coal, and any form of solid, liquid, or gaseous fuel derived from such material for the purpose of creating useful heat.

Freeboard Ratio. The ratio of the solvent cleaning machine freeboard height to the smaller interior dimension (length, width, or diameter) of the solvent cleaning machine.

Hydrochlorofluorocarbons (HCFCs). Compounds comprised of hydrogen, chlorine, fluorine, and carbon atoms. These compounds have many of the useful properties of chlorofluorocarbons

(CFCs), but are destroyed naturally in the lower atmosphere and do not persist to the same extent as CFCs. Only a fraction of HCFCs emitted can be transported to the ozone layer in the stratosphere where there chlorine could deplete ozone.

Incinerator. Any furnace used in the process of burning solid or liquid waste for the purpose of reducing the volume of the waste by removing combustible matter, including equipment with heat recovery systems for either hot water or steam generation.

Installation. A base, camp, post, station, yard, center, or other activity under the jurisdiction of the Secretary of a Military Department that is located outside the United States and outside any territory, Commonwealth, or possession of the United States.

Motor Vehicle. Any commercially-available vehicle that is not adapted to military use which is self-propelled and designed for transporting persons or property on a street or highway, including but not limited to passenger cars, light duty vehicles, and heavy duty vehicles.

Ozone-Depleting Substances (ODS). Those substances listed in Table C2.T10.

Pathological Waste. Waste material consisting of only human or animal remains, anatomical parts, and/or tissue, the bags/containers used to collect and transport the waste material, and animal bedding (if applicable).

Process Heater. A device that is primarily used to heat a material to initiate or promote a chemical reaction in which the material participates as a reactant or catalyst.

Pyrolysis. The endothermic gasification of hospital waste and/or medical/infectious waste using external energy.

Relevant mass flow. The relevant mass flow is the total emissions during one hour of operation under normal operation conditions and under the most unfavorable process conditions with regard to emissions from a facility.

Steam generating unit. A device that combusts any fuel and produces steam or heats water or any other heat transfer medium. This definition does not include nuclear steam generators or process heaters.

Substantially modified. Describes the condition of a facility/building that has been subjected to modification, the cost of which exceeds \$1 million, regardless of funding source. A modification to a facility is also considered substantial if it can detrimentally impact the environment. An increase in emissions, in general, will be regarded as detrimental.

Vapor Cleaning Machine. A batch or in-line solvent cleaning machine that boils liquid solvent generating solvent vapor that is used as a part of the cleaning or drying cycle.

Wood Residue. Bark, sawdust, slabs, chips, shavings, mill trim, and other wood products derived from wood processing and forest management operations.

C2.3 REQUIREMENTS**C2.3.1 Steam/Hot Water Generating Units**

The following requirements apply to steam/hot water generating units. Additional requirements pertaining to small and large heating plants are presented in Sections C2.3.14 and C2.3.15, respectively.

C2.3.1.1 Steam/hot water generating units and associated emissions controls must be designed to meet the emission standards that correspond to their rated heat output as shown in Table C2.T1. Alternative emission standards for periods of start up, shut down, malfunction, or when emergency conditions exist must be negotiated separately with the responsible administration or defined in the facility operating permit or applicable administrative prescriptions.

C2.3.1.2 Steam/hot water generating units that are subject to nitrogen oxides (NO_x) standards in Table C2.T1 must have a properly calibrated and maintained continuous emissions monitoring system (CEMS) to measure the waste gas as follows:

C2.3.1.2.1 For units burning solid fuel, units burning heating oil with a rated heat output of 5 megawatts (MW) or greater, and units with a design capacity between 5 and 25 MW: opacity.

C2.3.1.2.2 For fossil fuel fired units (solid and liquid) with a rated heat output of 50 MW or greater: NO_x and oxygen (O₂).

C2.3.1.2.3 For fossil-fuel fired units (gas) with a maximum rated heat output of 400 MW or greater: nitrogen monoxide (NO), nitrogen dioxide (NO₂), and O₂.

C2.3.1.2.4 If the emissions of NO₂ are less than 5 percent of the total NO_x-emissions, NO₂ may be calculated instead of measured.

C2.3.2 Incinerators

The following requirements apply to incinerators. Additional requirements pertaining to incinerators that combust solid waste are presented in Chapter 7, Solid Waste.

C2.3.2.1 Incinerators, regardless of type, must be installed and operated so that the emission limiting values presented in the Tables C2.T2 and C2.T3 are guaranteed. The emission limiting values are based on an oxygen content in the waste gas of 11 percent.

C2.3.2.2 New or substantially modified sewage sludge incinerators that burn more than 1 ton per day (tpd) of sewage sludge or more than 10 percent sewage sludge must also be designed to meet a particulate emission limit of 0.65 grams per kilogram (g/kg) dry sludge (1.30 pounds per ton dry sludge). Additionally, these incinerators must be designed to meet an opacity limit of 20 percent at all times, except during periods of start up, shut down, malfunction, or when emergency conditions exist.

- C2.3.2.3 New or substantially modified medical waste incinerators will be of a dual chamber design.
- C2.3.2.4 New and existing medical waste incinerators must be designed and operated according to the following good combustion practices (GCPs):
- Minimum temperature in primary chamber of 1400 to 1600 °F.
 - Minimum temperature in secondary chamber of 1800 to 2200 °F.
 - Incinerator operators must be trained in accordance with applicable Service requirements.
- C2.3.2.5 Incinerator burning units must be equipped with supplying burners that are fired with gas (natural gas, methane), liquid gas (e.g., liquid petroleum gas, propane), or heating oil extra light (e.g., No. 1 & No. 2 fuel oil, kerosene) during startup and during periods when the minimum temperature cannot be guaranteed.
- C2.3.2.6 Incinerators must be equipped with an automatic mechanism or system that feeds waste into the incinerator only at a minimum temperature higher than listed above.
- C2.3.2.7 Incinerators must be equipped with an automatic mechanism or system that feeds waste into the incinerator only if all continuously monitored emission values are within acceptable limits.
- C2.3.2.8 Vapors in storage tanks containing liquid fuels must be vacuumed off and burned in the incineration process.
- C2.3.3 Dry Cleaning Machines**
- C2.3.3.1 The following requirements apply to new and existing perchloroethylene (PCE) dry cleaning machines. These requirements do not apply to coin-operated machines. Existing sources must comply no later than 15 March 2003.
- C2.3.3.1.1 Emissions from existing PCE dry cleaning machines, at installations that use more than 2,000 gallons per year of PCE (installation wide) in their dry cleaning operations, must be controlled with a refrigerated condenser, or, if already installed, a carbon absorber. The temperature of the refrigerated condenser must be maintained at 45 °F or less. Dry cleaning machines and control devices must be operated according to manufacturer recommendations.
- C2.3.3.1.2 All new PCE dry cleaning systems must be of the dry-to-dry design with emissions controlled by a refrigerated condenser. The temperature of the refrigerated condenser must be maintained at 45 °F or less. Dry cleaning machines and control devices must be operated according to manufacturer recommendations.
- C2.3.3.2 Chemical dry cleaning machines must be installed and operated in such a way that:

1. The mass concentration of volatile halogenated hydrocarbons in the dryer air at the exit of the dryer does not exceed 2 grams per cubic meter (g/m³) while
 - the dryer is operated,
 - the ventilation is functioning,
 - the door is closed,
 - a minimum temperature of 308 °K (35 °C) of the treated goods is maintained, and
 - a rate of air exchange from 2 to 5 cubic meters (m³) per hour and per kg goods is maintained.
2. The system is equipped with an automatic lock for the loading door which guarantees that the conditions in Item 1 are observed.
3. Mass concentrations of volatile halogenated hydrocarbons in the undiluted waste gas after passing a separator shall not exceed 20 milligrams per cubic meter (mg/m³).
4. Filters used for cleaning solvents must be recyclable.

C2.3.3.3 After construction of a chemical dry cleaning facility, initial monitoring is required to be made not earlier than 3 months, nor later than 12 months, from the time that a facility is brought into operation. A permitted expert (*Sachverstaendiger*) must perform the monitoring. Initial monitoring is not necessary if continuous measurement equipment is installed.

C2.3.4 Chromium Electroplating and Chromium Anodizing Tanks

The following standards apply to new and existing chromium electroplating and anodizing tanks. Existing sources must comply no later than 15 March 2003.

- C2.3.4.1 Ventilation exhaust from new and existing tanks must be controlled by a wet scrubber, composite mesh-pad eliminator, fiber bed filter, or equivalent control device capable of limiting emissions to 0.015 milligrams per dry standard cubic meter (mg/dscm). Control devices must be operated according to manufacturer recommendations.
- C2.3.4.2 Alternatively, in lieu of control devices, decorative chromium and chromium anodize tanks may use chemical tank additives to prevent the surface tension from exceeding 45 dynes per centimeter (dynes/cm) provided that the surface tension is monitored prior to the first initiation of electric current on a given day and every 4 hours thereafter.

C2.3.5 Halogenated Solvent Cleaning Machines

The following requirements apply to the operation of surface treatment facilities, chemical dry cleaning plants, and extraction facilities using halogenated hydrocarbons with a boiling point up to 423° Kelvin (°K) (150 °C) at 1,013 millibars (mbar). The requirements do not apply to facilities that use mixtures of solvents that contain less than 1 percent of these volatile halogenated hydrocarbons.

- C2.3.5.1 The only volatile halogenated hydrocarbons allowed for use are tetrachloroethene, trichloroethene and dichloromethane. No additives are allowed if the additives are classified as carcinogenic compounds.
- C2.3.5.2 Trichloroethene is allowed for use only in surface treating facilities.
- C2.3.5.3 Dichloromethane is allowed for use only in surface treating facilities and in extraction facilities.
- C2.3.5.4 Cold cleaning machines (remote reservoir and immersion tanks) must be covered when not in use. Additionally, immersion type cold cleaning machines must have either a 1-inch water layer or a freeboard ratio of at least 0.75.
- C2.3.5.5 Ensure products are treated in closed containers only with an opening for evacuating the waste gas. State of the art controls are to be used to control emissions through sealing; separating waste gas from the process air; or modifying the treatment process. An automatic lock must be equipped to ensure nothing can be taken out before the mass concentration of the named substances in the removal area inside the machine is not higher than 1 g/m³.
- C2.3.5.6 Extracted waste gases must pass through a separator that guarantees a mass concentration of halogenated hydrocarbons below or equal to 20 mg/m³ in the treated waste gas. Separated halogenated hydrocarbons must be recycled. If only halogenated hydrocarbons containing more than 50 mass percent of dichloromethane are used, the mass concentration must not be higher than 50 mg/m³. Separators with exhaust gas volume flow rates above 500 cubic meters per hour (m³/hr) must be equipped either with devices for continuous measuring and recording the concentrations of volatile halogenated hydrocarbons or with devices that will automatically stop the operation if the mass concentration of the halogen compounds exceeds 1 g/m³.

C2.3.6 Ozone Depleting Substances

Ozone Depleting Substances (ODSs) are listed in Table C2.T10.

- C2.3.6.1 Any operation, maintenance, or shut-down procedures involving ODSs must not allow the substances to escape into the atmosphere and must conform to the state of the art practices, except for actual emergency use of fire extinguishing substances. Fully trained persons having the appropriate equipment will perform such work.
- C2.3.6.2 **Restricted Use ODSs.** The following requirements apply to restricted use ODSs identified in Table C2.T10; however, the requirements do not apply to the use of restricted use ODSs for research and analysis, sea-going vessels flying other than a German flag, nor aircraft registered in countries other than Germany.
- C2.3.6.2.1 It is prohibited to distribute or use products containing refrigerants containing more than 1 percent of chlorofluorocarbons (CFCs), other fully halogenated CFCs, or halons that are identified in Table C2.T10 as restricted use ODSs, carbon tetrachloride, or 1,1,1-trichloroethane.

C2.3.6.2.2 It is prohibited to distribute or use foam products that contain chlorofluorocarbons (CFCs), other fully halogenated CFCs, or halons that are identified in Table C2.T10 as restricted use ODSs, carbon tetrachloride, or 1,1,1-trichloroethane, or foam products that can release such substances.

C2.3.6.2.3 Containers or products except insulation products containing the restricted use ODSs (except Halon 1211, 1301, 2402, carbon tetrachloride, methylchloroform, and HCFC-22) must be marked with a permanent, easily noticeable and readable imprint, embossed mark, or sticker reading:

"ENTHAELT OZONABBAUENDE FCKW"
(CONTAINS OZONE-DEPLETING SUBSTANCES)

C2.3.6.2.4 Containers for fire extinguishing substances containing more than 1 percent by mass of Halon 1211, Halon 1301, or Halon 2402 must be marked with a permanent, easily noticeable and readable imprint, embossed mark, or sticker reading:

"ENTHAELT OZONABBAUENDES HALON"
(CONTAINS OZONE-DEPLETING HALON)

C2.3.6.3 **General Use Prohibition.** The distribution or use (i.e., utilization in maintenance or servicing of products and equipment) of the following ODSs is prohibited. Running an existing system without maintenance (e.g., using a refrigerator) would not be classified as use.

Chlorofluorocarbons (CFCs);
Other fully halogenated CFCs;
Halon (except as specified in C2.3.6.3.1);
Carbon tetrachloride;
1,1,1-trichloroethane; and
Hydrobromofluorocarbons.

C2.3.6.3.1 The use of Halons is permitted for critical uses (see Table C2.T20) only as they apply to research and analysis, sea-going vessels flying other than a German flag, and aircraft registered in countries other than Germany.

C2.3.6.4 **Hydrochlorofluorocarbons (HCFCs).** Except as specifically allowed in C2.3.6.5, the use of HCFCs is prohibited in the following applications:

C2.3.6.4.1 In aerosols.

C2.3.6.4.2 As solvents:

C2.3.6.4.2.1 In non-contained solvent uses (including open-top cleaners and open-top dewatering systems without refrigerated areas, in adhesives and mould-release agents when not employed in closed equipment, and for drain cleaning where HCFCs are not recovered);

C2.3.6.4.2.2 From 1 January 2002, in all solvent uses except precision cleaning of electrical and other components in aerospace and aeronautics applications, where use is prohibited beginning on 31 December 2008.

C2.3.6.4.3 As refrigerants:

C2.3.6.4.3.1 In equipment produced after 31 December 1995 for the following uses:

- In non-confined direct-evaporation systems,
- In domestic refrigerators and freezers,
- In motor vehicle, tractor and off-road vehicle or trailer air-conditioning systems operating on any energy source except for military applications where the use is prohibited beginning on 31 December 2008,
- In road public-transport air-conditioning.

C2.3.6.4.3.2 In equipment produced after 31 December 1997 for use in rail transport air-conditioning.

C2.3.6.4.3.3 In equipment produced after 31 December 1999 for the following uses:

- In public and distribution cold stores and warehouses,
- For equipment of 150 KW and over, shaft input.

C2.3.6.4.3.4 In all other refrigeration and air-conditioning equipment produced after 31 December 2000 with two exceptions:

- HCFCs can be used in fixed air-conditioning equipment with a cooling capacity of less than 100 KW until 1 July 2002.
- HCFCs can be used in reversible air-conditioning/heat pump systems until 1 January 2004.

C2.3.6.4.3.5 The use of virgin HCFCs in the maintenance and servicing of refrigeration and air-conditioning equipment shall be prohibited on 1 January 2010.

C2.3.6.4.3.6 The use of all HCFCs in the maintenance and servicing of refrigeration and air-conditioning equipment shall be prohibited on 1 January 2015.

C2.3.6.4.4 For the production of foams, except:

- Extruded polystyrene rigid insulating foams until 1 January 2002 as long as such foams are not used for insulated transport;
- Polyurethane foams for appliances until 1 January 2003; and
- Polyurethane flexible faced laminate foams and polyurethane sandwich panels, excluding where used for insulated transport, until 1 January 2003.

- C2.3.6.4.5 As carrier gas for sterilization substances in closed systems, in equipment produced after 31 December 1997.
- C2.3.6.4.6 In all other applications not referenced in C2.3.6.4.1 through C2.3.6.4.5.
- C2.3.6.5 The use of HCFCs shall be permitted:
- C2.3.6.5.1 In laboratory uses, including research and development.
- C2.3.6.5.2 As a feedstock (the term feedstock being defined as any substance that undergoes chemical transformation in a process in which it is entirely converted from its original composition and whose emissions are insignificant).
- C2.3.6.5.3 As halon substitutes in existing fire protection systems that are specified in Table C2.T20 under the following conditions:
- The original halons contained in such fire protection systems shall be replaced completely by the HCFC; and
 - The halons withdrawn shall be destroyed. DoD components are directed to turn-in restricted use ODSs for disposition in accordance with DoD 4160.21-M, Defense Materiel Disposition Manual, Chapter 10.
- C2.3.6.6 During the servicing and maintenance of equipment or before dismantling or disposal of equipment:
- C2.3.6.6.1 ODSs contained in refrigeration, air-conditioning and heat pump equipment (except domestic refrigerators and freezers), equipment containing solvents, and fire protection systems and fire extinguishers shall be recovered for disposition DoD 4160.21-M, Defense Materiel Disposition Manual, Chapter 10.
- C2.3.6.6.2 ODS contained in domestic refrigerators and freezers shall be recovered for disposition in accordance with DoD 4160.21-M, Defense Materiel Disposition Manual, Chapter 10 after 31 December 2001.
- C2.3.6.6.3 ODS contained in products, installations and equipment other than those mentioned in C2.3.6.6.1 and C2.3.6.6.2 shall be recovered for disposition in accordance with DoD 4160.21-M, Defense Materiel Disposition Manual, Chapter 10 if practical.
- C2.3.6.7 All precautionary measures practicable shall be taken to prevent and minimize leakage of ODSs. In particular, fixed equipment with a refrigeration fluid charge of more than 3 kilograms (kg) shall be checked for leakage annually.
- C2.3.6.8 All precautionary measures practicable shall be taken to prevent and minimize leakage of methyl bromide from fumigation installations and operations in which methyl bromide is used. Whenever methyl bromide is used in soil fumigation, the use

of virtually impermeable films for a sufficient time, or other techniques ensuring at least the same level of environmental protection shall be mandatory.

- C2.3.6.9 All precautionary measures practicable shall be taken to prevent and minimize leakage of ODSs used as feedstock and processing agents.
- C2.3.6.10 All precautionary measures practicable shall be taken to prevent and minimize any leakage of ODSs inadvertently produced in the course of the manufacture of other chemicals.

C2.3.7 Motor Vehicles and Fuel

The following criteria apply to DoD-owned motor vehicles.

- C2.3.7.1 Inspect all vehicles every two years to ensure that no one has tampered with the factory-installed emission control equipment.
- C2.3.7.2 Automobile fuels must contain less than 0.15 grams per liter (g/L) lead compounds expressed in terms of lead. A more restrictive standard of 0.013 g/L compounds expressed in terms of lead is applicable when the motor octane number of the fuel remains under 85 and the research octane number of the fuel remains under 95 (based on host nation octane numbers).
- C2.3.7.3 Chlorine or bromine compounds may not be used as additives in fuel (gasoline).
- C2.3.7.4 Diesel fuel used to operate diesel engines shall not exceed 0.20 percent sulfur compounds, calculated as sulfur, by weight.

C2.3.8 Permits and Notifications

- C2.3.8.1 DoD components may be required to obtain a permit for new regulated facilities (installed after 29 March 1998) or substantially modified regulated facilities. Procedures for obtaining permits or other authorizations are addressed in Chapter 1, Overview.
- C2.3.8.2 DoD components must comply with conditions contained in a permit. If the permit allows a less protective standard than prescribed in these FGS, the FGS will be the compliance standard.
- C2.3.8.3 DoD components must notify the licensing authorities prior to 29 March 1999 of existing facilities (installed prior to 29 March 1998) that require a permit.
- C2.3.8.4 DoD components must notify licensing authorities at least one month prior to modification, that has the potential to affect the facility's influence on the environment, of a regulated facility requiring a permit.
- C2.3.8.5 DoD components must comply with conditions contained in any administrative prescriptions for a regulated facility. If the administrative prescriptions allow a less protective standard than prescribed in these FGS, the FGS will be the compliance standard.

C2.3.9 Dust Emissions

- C2.3.9.1 Dust emissions contained in waste gas shall not exceed the values contained in Table C2.T4.
- C2.3.9.2 Inorganic dusty material emissions contained in waste gas shall not exceed the values contained in Table C2.T5.
- C2.3.9.3 If inorganic dusty materials of Class I and Class II coincide, the mass concentration in the waste gas must not exceed a total of 1 mg/m³ in addition to the values in C2.T5.
- C2.3.9.4 Potentially carcinogenic inorganic dusty materials are substances of Class III. If inorganic dusty materials of Class I and Class III or Class II and Class III coincide, the mass concentration in the waste gas must not exceed a total of 5 mg/m³ in addition to the values in Table C2.T5.
- C2.3.9.5 Physical conditions (i.e., pressure and temperature) during the discharge of waste gasses which may cause essential components of the inorganic dusty materials to become vaporous or gaseous will be monitored and controlled, within the bounds of current technology, as necessary to meet the mass concentrations identified above.
- C2.3.9.6 Machinery, equipment, or other facilities used for processing (e.g., crushing, sizing, mixing, heating, cooling, pelletizing, briquetting) or producing dusty goods shall be completely enclosed. Where dust-tight construction, especially at feeding, removal, or transfer points, is not possible, dust-containing waste gases shall be collected and fed to a dust collection system.
- C2.3.9.7 Closed installations such as conveyor belts, exhausters, or chain conveyor systems, shall be used for the transportation of dusty materials. Where enclosures are not or only partly possible, dust-containing waste gas shall be collected and fed to a deduster.
- C2.3.9.8 The handling of dusty materials requires the installation of exhausters and dedusters at:
- Stationary reception, transfer, and discharge points of grippers, shovel loaders, and transport units
 - Downspouts of loading facilities
 - Dispersion systems as parts of pneumatic or mechanic unloading facilities
 - Pouring gutters of facilities used for unloading road and rail vehicles
 - Siphons
- C2.3.9.9 When dust-containing waste gases cannot be collected, the discharge height at discharge points shall be, automatically, if possible, adjusted to the height of the pile, or the discharge velocity of the bulk goods at the downspout shall be kept as low as possible.
- C2.3.9.10 When filling closed transport containers with dusty goods, the displacement air shall be collected and fed to a dust collector.

- C2.3.9.11 If dust emissions may result from the use of roadways, the roadways within the facility shall be covered with bituminous material, concrete, or equivalent material and cleaned according to their levels of pollution. This does not apply to roadways in quarries and raw material extraction sites.
- C2.3.9.12 Pollution of roadways caused by vehicles handling dusty materials after leaving a facility shall be avoided (e.g., by employing tire washing systems or regular vehicle cleaning).
- C2.3.9.13 The following measures shall be taken into account to eliminate or reduce dusty emissions during the storage of dusty materials:
- Storage in silos
 - Providing a roof and complete side coverage
 - Surface covering
 - Planting
 - Vegetated earth embankments, windbreak plantings or hedges
 - Permanently maintaining a sufficient moisture level on pile surfaces
- C2.3.9.14 When planning for the establishment or removal of piles, or the operation of equalization facilities which do not have a roof and complete side coverage or are not covered in some other way, preventative measures, such as the following, shall be taken:
- Measures previously noted in 2.3.9.13.
 - Filling or removing the dusty materials behind embankments
 - Sufficient humidification at the pile sites
 - Stopping work during weather conditions which favor the generation of emissions to a high extent (e.g. long-lasting droughts, high wind velocities)
 - Aligning the longitudinal axis of the piles with the prevailing wind direction

C2.3.10 Vaporous or Gaseous Inorganic Substances

The vaporous or gaseous inorganic substances listed in Table C2.T6 must not exceed the specified mass concentrations in the waste gas individually.

C2.3.11 Organic Substances

- C2.3.11.1 Organic substances, categorized as Classes I through III in Table C2.T7, shall not exceed the mass concentrations specified in Table C2.T8 with regard to the mass flow, even if several substances of the same class are present. An organic substance that is not categorized as Class I, II, or III shall be assigned to that class which contains substances it is most similar to in terms of its influence on the environment. For organic dusty materials belonging to Class II or Class III, the requirements of C2.3.9.1 (total dust) shall apply instead of those contained in Table C2.T8.
- C2.3.11.2 In addition to the limitations contained in Table C2.T8, the mass concentrations of organic substances in the waste gas shall not exceed a total of 0.15 g/m³, if organic

substances of several classes are present. The relevant mass flow then is 3 kilograms per hour (kg/hr) or more.

- C2.3.11.3 For substances which cannot be broken into Class I, Class II, or Class III because they are not easily degradable, easily accumulated, or of high toxicity, or the substances cause other harmful environmental impacts, the mass flow must be as low as possible if not excessively burdensome. This may require special processing procedures or restrictions on the type of substances used in addition to waste gas purification measures. Examples for those substances are polyhalogenated dibenzodioxins, polyhalogenated dibenzofurans, or polyhalogenated biphenyls.
- C2.3.11.4 Leaks at pumps for liquid organic substances in general shall be avoided as far as possible. Diffuse emissions of organic carcinogenic substances out of pumps shall be minimized.
- C2.3.11.5 Barrier liquids of compressors for gases shall not be degassed into the atmosphere, if the gases contain:
- more than 10 milligrams per kilogram (mg/kg) of carcinogenic substances of Class I (see Table C2.T9) or organic dust substances belonging to Class II or III;
 - more than 5 grams per kilogram (g/kg) of carcinogenic substances of Class II or III (see Table C2.T9); or
 - more than 5 g/kg of substances of Class I.
- C2.3.11.6 Fittings shall be made airtight if the following are handled:
- more than 10 mg/kg of carcinogenic substances of Class I (see Table C2.T9) or organic dust substances belonging to Class II or III;
 - more than 5 g/kg of carcinogenic substances of Class II or III (see Table C2.T9); or
 - more than 5 g/kg substances of Class I.
- C2.3.11.7 While filling organic substances, emissions must be avoided by a gas pendulum system or by other means such as purification of the captured substances.
- C2.3.12 Carcinogenic Substances**
- C2.3.12.1 Carcinogenic substances of the classes listed in Table C2.T11 must not exceed the specified concentrations in the waste gas, either individually or by class.
- C2.3.12.2 If carcinogenic substances of Class I and Class II coincide, the mass concentration in the waste gas must not exceed a total of 1 mg/m³ in addition to that presented in Table C2.T11.
- C2.3.12.3 If carcinogenic substances of Class I and Class III, or Class II and Class III coincide, the mass concentration in the waste gas must not exceed a total of 5 mg/m³ in addition to that presented in Table C2.T11.

C2.3.13 Odor

Emission limiting values regarding odor do not exist; however, emissions from a facility that contain strong smelling substances shall be minimized.

C2.3.14 Small Heating Units

The following requirements are applicable to small heating units that do not require a permit and have a maximum rated heat output in relation to the used fuels as listed in Table C2.T12.

- C2.3.14.1 Burning of waste is prohibited.
- C2.3.14.2 Heating plants that will not be operated for more than 3 months are excluded from these requirements.
- C2.3.14.3 Flue gas must be discharged in such a manner that a free air stream will provide an undisturbed dispersion. Flue gas of heating plants with a rated heat output higher than 1 MW must be discharged via a stack with a minimum height of 10 m above ground and 3 m above ridges.
- C2.3.14.4 Within 4 weeks of installation or within 4 weeks of substantial modification of a unit of 4 kilowatts (KW) or more, an inspection of the unit must be conducted by a competent authority such as a the district chimney sweep (*Bezirksschornsteinfeger*).
- C2.3.14.5 Coal-burning furnaces rated at 15 KW or more with a mechanical feed must be inspected annually by a competent authority such as a district chimney sweep (*Bezirksschornsteinfeger*).
- C2.3.14.6 Oil- or gas-burning furnaces rated at 11 KW or more must be inspected annually by a competent authority such as the district chimney sweep (*Bezirksschornsteinfeger*).
- C2.3.14.7 The following requirements apply to solid fuel fired heating plants.
 - C2.3.14.7.1 Open fire boxes may be used occasionally, only natural wood is allowed.
 - C2.3.14.7.2 Coals must have a sulfur content of 1 percent or less unless briquettes of hard coal or brown coal are treated to limit emissions of sulfur dioxide accordingly.
 - C2.3.14.7.3 Flue gas emissions from a heating plant must have a Ringelmann Scale gray value less than 1.
 - C2.3.14.7.4 Heating plants with a rated heat output greater than 15 KW must be installed and operated in such a manner that the emission limiting values in the Table C2.T13 are observed.
- C2.3.14.8 The following requirements apply to oil- and gas-fired heating plants.
 - C2.3.14.8.1 All reasonable measures to reduce nitrogen oxide emissions through firing techniques should be employed.

- C2.3.14.8.2 For evaporation burners, the dust emissions in the flue gas (soot number) cannot exceed 2 and the flue gas must be free of oil derivatives.
- C2.3.14.8.3 For atomizing burners, the dust emissions in the flue gas (soot number) cannot exceed 1 and the flue gas must be free of oil derivatives
- C2.3.14.8.4 The maximum allowable energy loss for heating plants - new or substantially modified after 31 December 1997 - in the waste gas shall not exceed the limits shown in the Table C2.T14.
- C2.3.14.8.5 For all furnaces installed before 31 December 1997 the allowable energy losses shown in the Table C2.T15 must be observed until 1 November 2004.

C2.3.15 Large Heating Plants

The following requirements are applicable to large heating plants that require a permit and have a rated heat output in relation to the used fuels as listed in Table C2.T16.

- C2.3.15.1 The following requirements apply to solid fuel-fired heating plants with a rated heat output of 1 MW to 50 MW.
 - C2.3.15.1.1 Only coals and wood (non-laminated or treated with wood preservatives) are allowed as fuel.
 - C2.3.15.1.2 Emissions shall not exceed the values in Table C2.T17.
 - C2.3.15.1.3 If the emissions value of sulfur dioxide and sulfur trioxide of 0.40 g/m³ for fluidized bed combustion is not economically feasible, a sulfur emission ratio of 25 percent shall not be exceeded.
 - C2.3.15.1.4 When using coal in other than fluidized bed combustion all reasonable measures shall be taken to reduce sulfur oxide emissions. In some cases, the addition of alkaline sorbents to the fuel or into the furnace can reduce the sulfur emission ratio up to 50 percent.
- C2.3.15.2 The following requirements apply to solid fuel-fired heating plants with a rated heat output of greater than 50 MW.
 - C2.3.15.2.1 Only coals and wood (including wood coated with organic halogenated compounds) are allowed as fuel.
 - C2.3.15.2.2 During heating plant operation, the temperature of the exhaust gases leaving the stack must be maintained at no less than 345 °K. This requirement does not apply to power plants whose exhaust gases are discharged through a cooling tower.
 - C2.3.15.2.3 The following emission values are based on an oxygen content in the flue gas of 7 percent for grate firing and fluidized bed incineration, 6 percent for

particulate combustion with dry ash removal, and 5 percent for particulate combustion with wet ash removal.

- C2.3.15.2.3.1 The particle emissions must not exceed 50 mg/m³.
- C2.3.15.2.3.2 For units constructed on or later than 1 July 1983, the particle emissions must not exceed 80 mg/m³ for combustion units using brown coal or 125 mg/m³ for combustion units using other solid fuel.
- C2.3.15.2.3.3 The emissions of sulfur dioxide and sulfur trioxide, indicated as sulfur dioxide, must not exceed:
1. 400 mg/m³ and a sulfur emission ratio of 15 percent. If - when using state-of-the-art technology - a reduction of SO_x emissions to these levels cannot be achieved because of an extremely high or inconsistent sulfur content in the fuel, the desulfurizing equipment is to be operated continuously at its highest separating capacity. A concentration of 650 mg/m³ in the exhaust gas shall never be exceeded.
 2. Deviating from Item 1., 2,000 mg/m³ and a sulfur emission ratio of 40 percent for combustion with grate or coal dust firing and a heat output from 100 MW up to 300 MW.
 3. Deviating from Item 1., 2,000 mg/m³ for combustion with grate or coal dust firing and a heat output up to 100 MW.
 4. Deviating from Item 1., 400 mg/m³ and a sulfur emission ratio of 25 percent for combustion with a fluidized bed with coal and a heat output of up to 300 MW.
 5. Deviating from Item 3., for a period of up to one year, an emission of 2,500 mg/m³ can be allowed by the responsible administration if it can be proven that during this time period suitable low sulfur coal is not available for the facility and the stack height is sufficient to handle the increased sulfur content of the exhaust gas.
 6. A combustion facility may also be operated during a failure of its desulfurizing equipment if the downtime does not exceed 72 consecutive hours and a total of 240 hours during one calendar year. The failure must be notified to the responsible administration immediately. Emissions up to twice the stated standard are allowed during startup times if, for technical reasons, they cannot be avoided.
- C2.3.15.2.3.4 Flue gas emissions will meet the following limitations on nitrogen monoxide and nitrogen dioxide, indicated as nitrogen dioxide:
1. For units permitted before 1 July 1983 emissions must not exceed 1.3 g/m³ for hard coal dust firing with dry ash removal, 2.0 g/m³ for

hard coal dust firing with wet ash removal, 1.0 g/m³ in all other instances where solid fuels are burned.

2. For other units emissions must not exceed 800 mg/m³.
3. For combustion facilities using hard coal dust firing with wet ash removal the emissions must not exceed 1,800 mg/m³, based on an oxygen content of 5 percent in the waste gas.
4. All reasonable measures to further reduce nitrogen oxide emissions through firing techniques should be taken.

C2.3.15.2.3.5 Flue gas emissions will meet the following limitations on halogenated compounds:

1. For units permitted before 1 July 1983, no restrictions apply.
2. Combustion units with grate firing or dust firing are to be operated in such a manner that the emissions of inorganic gaseous halogenated compounds do not exceed:
 - 200 mg/m³ of inorganic gaseous chlorine compounds (indicated as hydrochloric acid) and 30 mg/m³ of inorganic gaseous fluoride compounds (indicated as hydrogen fluoride), at a heat output of up to or equal to 300 MW.
 - 100 mg/m³ of inorganic gaseous chlorine compounds (indicated as hydrochloric acid) and 15 mg/m³ of inorganic gaseous fluoride compounds (indicated as hydrogen fluoride), at a heat output greater than 300 MW.
3. A combustion facility may also be operated during a failure of its desulfurizing equipment if the downtime does not exceed 72 consecutive hours and a total of 240 hours during one calendar year. The failure must be notified to the responsible administration immediately. Emissions up to twice the stated standard are allowed during startup times if, for technical reasons, they cannot be avoided.
4. All reasonable measures to further reduce nitrogen oxide emissions through firing techniques should be taken.

C2.3.15.2.4 During the operation, the temperature of the exhaust gases leaving the stack must be maintained at no less than 345 °K. This requirement does not apply to power plants whose exhaust gases are discharged through a cooling tower.

C2.3.15.3 The following requirements apply to oil-fired heating plants with a rated heat output of 1 to 50 MW.

- C2.3.15.3.1 The following emission values are based on an oxygen content in the flue gas of 3 percent.
- C2.3.15.3.1.1 When using heating oil per DIN Standard 50603 Part 1 (December 1981 edition), the dust emissions in the flue gas (soot number) shall not exceed one and the flue gas must be free of oil derivatives. Filter papers used for soot measurements should not show any visible signs of oil derivatives.
 - C2.3.15.3.1.2 Particulate emissions in the waste gas shall not exceed 80 mg/m³.
 - C2.3.15.3.1.3 Particulate emissions shall not exceed 50 mg/m³ for units with a rated heat output of 5 MW or more when burning heating oil with a sulfur mass content of more than 1 percent.
 - C2.3.15.3.1.4 Requirements associated with inorganic dusty materials do not apply when using low-ash oil if the above particulate requirements are met without a dedusting system.
 - C2.3.15.3.1.5 Carbon monoxide emissions in the waste gas shall not exceed 0.17 g/m³.
 - C2.3.15.3.1.6 Nitrogen monoxide and nitrogen dioxide emissions, indicated as nitrogen dioxide in the waste gas shall not exceed 0.25 g/m³ when using heating oil according to DIN Standard 51603, Part 1 (December 1981 edition).
 - C2.3.15.3.1.7 Nitrogen monoxide and nitrogen dioxide emissions, indicated as nitrogen dioxide in the waste gas shall not exceed 0.45 g/m³ when using other heating oil.
 - C2.3.15.3.1.8 All reasonable measures to further reduce nitrogen oxide emissions through firing techniques should be employed.
 - C2.3.15.3.1.9 The emissions of sulfur dioxide and sulfur trioxide, indicated as sulfur dioxide in the waste gas shall not exceed 1.7 g/m³. All reasonable measures to reduce sulfur oxide emissions, to include using low-sulfur oil, shall be applied.
- C2.3.15.3.2 Furnaces with a rated heat output up to 5 MW shall only use heating oil with a sulfur mass content according to DIN Standard 51603, Part 1 (December 1981 edition) unless desulfurization facilities ensure that no higher sulfur dioxide emissions are generated than if a heating oil according to DIN Standard 51603, Part 1 is used.
- C2.3.15.4 The following requirements apply to oil-fired heating plants with a rated heat output of greater than 50 MW.
- C2.3.15.4.1 The following emission values are based on an oxygen content in the flue gas of 3 percent.

- C2.3.15.4.1.1 During heating plant operation the temperature of the exhaust gases leaving the stack must be maintained at no less than 345 °K. This requirement does not apply to power plants whose exhaust gases are discharged through a cooling tower.
- C2.3.15.4.1.2 Particulate emissions must not exceed 50 mg/m³ after the removal of the adsorbed sulfuric acid.
- C2.3.15.4.1.3 If fuel oils covered by DIN Standard 51603, Part 1 (version of December 1981) or DIN Standard 51603, Part 2 (version of October 1976) with a nickel content of more than 12 mg/kg of fuel are used in existing facilities for liquid fuels, or if liquid fuels other than those covered by DIN Standard 51603 are used, the particulate emissions of arsenic, lead, cadmium, chromium, cobalt, nickel, and their compounds (indicated as elements) must not exceed a total concentration 2 mg/m³.
- C2.3.15.4.1.4 Carbon monoxide emissions in the waste gas must not exceed 175 mg/m³.
- C2.3.15.4.1.5 Nitrogen monoxide and nitrogen dioxide emissions, indicated as nitrogen dioxide must not exceed 450 mg/m³.
- C2.3.15.4.1.6 All reasonable measures to further reduce nitrogen oxide emissions through firing techniques should be employed.
- C2.3.15.4.1.7 For units permitted on or later than 1 July 1983 the emissions of nitrogen monoxide and nitrogen dioxide, indicated as nitrogen dioxide must not exceed 700 mg/m³.
- C2.3.15.4.1.8 Flue gas discharged into the atmosphere will meet the following limitations on sulfur dioxide and sulfur trioxide, indicated as sulfur dioxide:
1. The emissions must not exceed 400 mg/m³ and the sulfur emission ratio does not exceed 15 percent. If, when using state-of-the-art technology, a reduction of SO_x emissions to these levels cannot be achieved because of an extremely high or inconsistent sulfur content in the fuel, then the desulfurizing equipment must be operated constantly at its highest separating capacity. A concentration of 650 mg/m³ must not be exceeded.
 2. Item 1 notwithstanding, combustion facilities for liquid fuels with a heat output from 100 to 300 MW are to be operated in such a way, that the emissions do not exceed 1,700 mg/m³ and the sulfur emission ratio does not exceed 40 percent.
 3. Items 1 and 2 notwithstanding, a combustion facility may be operated if it uses a light fuel or diesel oil with a maximum sulfur

compounds content, calculated as sulfur, not exceeding 0.20 percent of the weight.

4. Item 1 notwithstanding, combustion facilities with a rated heat output up to 100 MW are to be operated in such a way, that the emissions do not exceed 1,700 mg/m³.
5. Item 4 notwithstanding, emissions of up to 3,400 mg/m³ can be allowed by responsible administration for up to 6 months if it can be proved that
 - during this time period, low sulfur fuel oil needed to meet the emission limits is not available; and
 - the stack height is sufficient to handle the increased sulfur content in the exhaust gas.

C2.3.15.4.2 When fuel oils other than those covered by DIN Standard 51603, Part 1 (published December 1981) or DIN Standard 51603, Part 2 (published October 1976) are burned, the emission values for inorganic gaseous chlorine compounds (given as hydrochloric acid) must not exceed 30 mg/m³ and the emission values for inorganic gaseous fluoride compounds (indicated as hydrogen fluoride) must not exceed 5 mg/m³.

C2.3.15.5 The following requirements apply to gas-fired heating plants with a rated heat output of less than 100 MW.

C2.3.15.5.1 The following emission values are based on an oxygen content in the flue gas of 3 percent.

C2.3.15.5.1.1 Particulate emissions in the waste gas shall not exceed 5 mg/m³.

C2.3.15.5.1.2 Carbon monoxide emissions in the waste gas shall not exceed 0.1 g/m³.

C2.3.15.5.1.3 Sulfur dioxide and sulfur trioxide emissions, indicated as sulfur dioxide, in the waste gas shall not exceed 35 mg/m³.

C2.3.15.5.1.4 Nitrogen monoxide and nitrogen dioxide emissions, indicated as nitrogen dioxide, in the waste gas shall not exceed 0.20 g/m³.

C2.3.15.5.1.5 Sulfur dioxide and sulfur trioxide emissions, indicated as sulfur dioxide, in the waste gas shall not exceed 5 mg/m³ if liquid gas is used.

C2.3.15.5.1.6 Nitrogen oxides emissions should be reduced using the best available technology when using process gases, which contain additional nitrogen compounds.

C2.3.15.6 The following requirements apply to gas-fired heating plants with a rated heat output of 100 MW or greater.

- C2.3.15.6.1 The following emission values are based on an oxygen content in the flue gas of 3 percent.
- C2.3.15.6.1.1 During heating operation the temperature of the exhaust gases leaving the stack must be maintained at no less than 345 °K. This requirement does not apply to power plants whose exhaust gases are discharged through a cooling tower.
 - C2.3.15.6.1.2 Particulate in flue gas emissions must not exceed 5 mg/m³.
 - C2.3.15.6.1.3 Carbon monoxide emissions must not exceed 100 mg/m³.
 - C2.3.15.6.1.4 Nitrogen monoxide and nitrogen dioxide emissions, indicated as nitrogen dioxide, must not exceed 350 mg/m³ except that for units constructed before 7 January 1989 it may be as high as 500 mg/m³. Measures to further reduce emissions by fuel-engineering or other state-of-the-art actions should be pursued.
 - C2.3.15.6.1.5 Sulfur dioxide and sulfur trioxide emissions, indicated as sulfur dioxide in the waste gas, must not exceed 35 mg/m³. Sulfur dioxide and sulfur trioxide emissions, indicated as sulfur dioxide in the waste gas must not exceed 5 mg/m³ if liquid gas is used.
- C2.3.15.7 For mixed fuel combustion facilities with a rated heat output of less than 50 MW, the defined emission values for the respective fuels shall be determined by comparing the energy applied with each fuel to the total amount of applied energy. The emission values relevant to each furnace may be reached by adding these determined values. This notwithstanding, the emission values for the fuel with the highest emission value applies, if during the operation of the facility, this fuel accounts for at least 70 percent of the total amount of applied energy.
- C2.3.15.8 The following requirements are for mixed fuel combustion facilities with a rated heat output of 50 MW or more.
- C2.3.15.8.1 Emission limits for each individual fuel must be obtained based on the ratio of the heat content of the individual fuel to the total heat content of the fuel mixture. The emission values relevant to each facility may be reached by adding these determined values. This notwithstanding, the provisions for the fuel with the highest emission limit apply, if this fuel accounts for at least 50 percent of the total heat content during the facility's operation.
 - C2.3.15.8.2 During the operation of mixed fuel combustion facilities, the temperature of the exhaust gases leaving the stack must be maintained at no less than 345 °K. This requirement does not apply to power plants whose exhaust gases are discharged through a cooling tower.
- C2.3.15.9 The following requirement is for multi-fuel combustion facilities with a rated heat output of less than 50 MW.

- C2.3.15.9.1 In cases of multifuel combustion, the requirements set for each individual fuel apply. If there is a switch from solid to gaseous fuel or from solid fuel to heating oil according to DIN Standard 51603, Part 1 (December 1981 edition), particulate emissions in the waste gas shall not exceed the emission limitations for solid fuels. This applies for a period of 4 hours after the switchover.
- C2.3.15.10 The following requirements are for multi-fuel combustion facilities with a rated heat output of 50 MW or more.
- C2.3.15.10.1 In cases of multifuel combustion, the requirements set for each individual fuel apply. If there is a switch from solid to gaseous fuel or from solid fuel to heating oil according to DIN Standard 51603, Part 1 (December 1981 edition), particulate emissions in the waste gas shall not exceed the emission limitations for solid fuels. This applies for a period of four hours after the switchover.
- C2.3.15.10.2 During the operation the temperature of the exhaust gases leaving the stack must be maintained at no less than 345 °K. This requirement does not apply to power plants whose exhaust gases are discharged through a cooling tower.
- C2.3.15.11 For fluidized bed combustion operated as mixed fuel combustion or multiple fuel combustion, particulate emissions shall not exceed 0.15 g/m³ for units with a rated heat output of 1 to 5 MW and 50 mg/m³ for units with a rated heat output greater than 5 MW.
- C2.3.16 Stationary Internal Combustion Engines, Gas Turbines, and Test Stands**
- C2.3.16.1 Particle emissions in waste gas of internal combustion engines (i.e., compression ignition engines operated on liquid fuels) shall not exceed 0.13 g/m³. Internal combustion engines must also be equipped with a soot filter.
- C2.3.16.2 Carbon monoxide emissions in waste gas of internal combustion engines shall not exceed 0.65 g/m³.
- C2.3.16.3 Nitrogen oxide emissions in the waste gas of internal combustion engines (measured as nitrogen dioxide) shall not exceed the limits presented in Table C2.T18.
- C2.3.16.4 The mass content of sulfur in liquid fuels used in internal combustion engines must be in accordance with DIN Standard 51603 Part 1 (December 1981), if not, adequate emission reduction measures must be applied.
- C2.3.16.5 Emission limit values for gas turbines are presented in Table C2.T19. For gas turbines with a thermal efficiency of greater than 30 percent, the emission limit values shall be increased in proportion to the percentage of improvement of efficiency.

- C2.3.16.6 The mass content of sulfur in liquid fuels used in gas turbine engines must be in accordance with DIN Standard 51603 Part 1 (December 1981); if not, adequate emission reduction measures must be applied.
- C2.3.16.7 When the mass flow of nitrogen oxides is greater than 5 kilograms per hour (kg/hr) (measured as nitrogen dioxide), state of the art measures shall be implemented to reduce nitrogen monoxide and nitrogen dioxide emissions from combustion engine test stands.
- C2.3.16.8 For combustion engine test stands using residual oils or comparable fuels, measures shall be established to limit particulate and sulfur oxide emissions.
- C2.3.16.9 State of the art measures shall be implemented to reduce the emissions of organic substances.
- C2.3.16.10 Engine test stands must be equipped with a catalytic converter and a soot filter.

C2.3.17 Spray Painting Facilities

- C2.3.17.1 Facilities performing spray painting operations require an emission permit if either of the following conditions are met:
- coatings (e.g., lacquers, paints) containing organic solvents are used in a quantity of at least 25 kg per hour; or
 - coatings (e.g., lacquers, paints) containing synthetic resin (i.e., reacting through a catalyst) are used in a quantity of at least 10 kg per hour.
- C2.3.17.2 If a facility does not require a permit, it must still avoid producing harmful emissions to the extent possible in accordance with state of the art methods and procedures.
- C2.3.17.3 During spray painting activities using paint dryers, emissions of organic substances shall not exceed the following mass concentrations:
- C2.3.17.3.1 Emissions of organic materials in the waste gas of dryers shall not exceed 50 mg/m³, indicated as total carbon.
- C2.3.17.3.2 Emissions of particulate matter (paint particles) in the waste gas of dryers shall not exceed 3 mg/m³.

C2.3.18 Printing Strip or Plate-Like Materials with Rotary Presses

Emissions of ethanol in waste gas shall not exceed 0.50 g/m³, when using water-reducible printing inks containing only ethanol as an organic solvent and the solvent does not exceed 25 percent.

C2.3.19 Wood Working Facilities

The following requirements apply to the installation and operation of any facility working wood that produces wood dust or chips, including installation and operation of transportation and storage equipment.

- C2.3.19.1 Equipment to capture and dedust waste air must be installed if other means are not sufficient to ensure the emission limiting value for dust identified in C2.3.9.2.
- C2.3.19.2 Mass concentration of dust and chips in the waste gas must not exceed 20 mg/m³.
- C2.3.19.3 Wood dust and chips must be stored in bunkers, silos, or closed rooms.
- C2.3.19.4 Storage and dedusting equipment must be emptied in a manner that minimizes the emissions of wood dust and chips.

C2.3.20 Fuel Dispensing Facilities

- C2.3.20.1 The following requirements apply to facilities, both mobile and non-mobile, that are used for the storage, transport, and dispensing of gasoline (*benzin*).
 - C2.3.20.1.1 Storage tanks that are stationary above-ground systems must be painted with a paint that will reflect at least 70 percent of the sun's energy at the time of painting and 50 percent on a permanent basis.
 - C2.3.20.1.2 Storage tanks with fixed-roofs are to be equipped with vacuum/pressure valves unless prohibited for safety or valid technical reasons.
 - C2.3.20.1.3 Storage tanks with floating roofs are to be equipped with primary and secondary seals. The emission reduction should reach at least 95 percent in comparison to fixed-roof tanks without an internal floating cover.
 - C2.3.20.1.4 Storage tanks in tank farms with more than 25,000 tons dispensing capacity are to be installed and operated as fixed-roof tanks with an emission control system, fixed-roof tanks with internal floating cover, or floating-roof tanks.
 - C2.3.20.1.5 Fuel vapors are to be captured and led to an exhaust cleaning system or gas pendulum system during filling operations.
 - C2.3.20.1.6 Gas pendulum systems must meet the following technical standards: fuel flow will only be released when equipment is connected to the gas pendulum system; and no fuel vapors will be discharged to the atmosphere during operation (except for safety releases).
 - C2.3.20.1.7 Exhaust cleaning systems in regulated facilities must be installed and operated in such a manner that the mass concentration of total carbon is less than 0.15 g/m³ at a mass flow of 3 kg/hr or more, or less than 5 g/hr if the mass flow is less than 3 kg/h.

- C2.3.20.1.8 Exhaust cleaning systems in other facilities must be installed and operated in such a manner that the cleaning ratio is at least 97 percent and the mass concentration in the waste gas is not higher than 35 g/m³ as mean value per hour.
- C2.3.20.1.9 Facilities must be operated in such a manner that dispensing is interrupted immediately if vapors are emitted.
- C2.3.20.1.10 Mobile tanks must be equipped with systems that hold back vapors and allow the gas pendulum connection at a filling station.
- C2.3.20.1.11 Storage tanks of filling stations with a dispensing capacity of more than 100 m³ per year must be equipped with a gas pendulum system.
- C2.3.20.1.12 A system in non-regulated facilities equipped with a gas pendulum system must be inspected before being placed in action. Thereafter, the system must be inspected at least every 5 years. The inspection needs to be done by a permitted expert (*Sachverstaendiger*). Written records of the testing and performed corrective actions must be kept in accordance with Service policy.
- C2.3.20.1.13 If a system in non-regulated facilities is equipped with a purification system instead of a gas pendulum system for vapor recovery, compliance must be verified by testing not earlier than 3 months and not later than 6 months after start-up of the system. Thereafter, the system must be inspected at least every 3 years. A permitted expert (*Sachverstaendiger*) must perform the tests. Written records of tests and inspections must be kept in accordance with Service policy.
- C2.3.20.1.14 The requirements regarding gas pendulum systems and exhaust gas cleaning must be regarded at the latest on 1 July 2003.
- C2.3.20.2 The following requirements apply to the installation and operation of gas stations for vehicles (gasoline only).
- C2.3.20.2.1 When filling the tank of a motor vehicle, vapors must be captured and returned to the storage tank by a gas pendulum system according to the state of the art. This requirement does not apply to gas stations that were already in operation prior to 1 January 1993 and that do not dispense more than 1,000 m³ of benzene per year.
- C2.3.20.2.2 A gas pendulum system without negative pressure support is considered state of the art if:
- it is equipped with faucet valves which ensure a tight connection with the gas tank of the motor vehicle and if the filler pipe is suitable for vapor recovery,
 - the free passage of the gas through the recovery system with low flow resistance is guaranteed,

- the counter-pressure at the faucet valve does not exceed the maximum specified in the manufacturer's specifications/directions,
- the recovery pipes have a minimum slope of at least 1 percent throughout their length starting at the fuel-pump and ending at the storage tank, and
- the gasket collars of the pump valves do not show any cracks, holes, or other defects which would allow leakage.

C2.3.20.2.3 A gas pendulum system without negative pressure support is considered state of the art if the ratio of the volume of the returned fuel-air mixture and filled fuel does not exceed 105 percent.

C2.3.20.2.4 The operator of a gas station must use the services of a qualified person (*Gekennzeichnet Einzelperson*) to test and inspect the vapor recovery system at least once a year to ensure its impeccable condition. If deficiencies are detected, the operator must immediately correct them. Written reports of inspection and repairs must be kept for at least 3 years at the facility.

C2.3.20.2.5 The operator of a gas station must use a permitted expert (*Sachverstaendiger*) to ensure that the requirements regarding gas pendulum systems are met at the latest 6 weeks after the gas recovery system has been installed. Thereafter, the system must be inspected at least every 5 years. Written records of the testing and performed corrective actions must be kept for at least 5 years.

C2.3.20.2.6 If the inspection finds that the requirements are not met, immediate repairs must be conducted and a re-inspection must be conducted within 6 weeks from the first inspection.

C2.3.21 Measuring and Monitoring Emissions

C2.3.21.1 A permitted expert must conduct air emission measuring and monitoring activities.

C2.3.21.2 After construction or substantial modification of a facility, initial measuring is required. Measurements, in general, shall be made not earlier than 3 months, and not later than 12 months, from the time that a steady state mode of operation is reached. Thereafter, confirming measurements shall be made at least every 3 years. Individual measurements may be waived if the attainment of emission limits can be sufficiently demonstrated by other tests. Initial or confirming measurements are not required if continuous measurements are mandated.

C2.3.21.3 Emissions shall be monitored through continuous measurements if a determined relevant mass flow of emitted substances is exceeded and emission limiting values are determined. Continuous measurements are not required if it can be shown by other methods that emission standards are met. Acceptable alternatives would include the demonstrated continuous efficiency of the emission reducing equipment, analysis of the composition of the fuels or raw materials, or analysis of the process

conditions. If the air polluting substances in the waste gas are in a constant ratio to each other, continuous measurements may be limited to the primary component.

- C2.3.21.4 Facilities with particulate emission mass flows of 2 to 5 kg/hr shall be equipped with measuring instruments at the relevant sources, which continuously determine waste gas opacity (e.g., through optical transmission).
- C2.3.21.5 Facilities with particulate emission mass flows of more than 5 kg/hr shall be equipped with measuring instruments at the relevant sources, which continuously determine particulate emission mass concentrations.
- C2.3.21.6. If particulate emissions contain carcinogenic, inorganic dusty substances, or organic substances of Class I and if the mass flow of one of the substances is 5 or more times greater than the respective mass flows, the facility shall be equipped with measuring instruments at the relevant sources, which continuously determine the total particulate concentrations.
- C2.3.21.7 If vaporous and gaseous substances in excess of the following emission mass flow values are contained in the waste gas, measuring instruments shall be installed at the relevant sources that continuously determine the mass concentrations of the respective substances:
- sulfur dioxide, 50 kg/hour
 - nitrogen monoxide and dioxide, 30 kg/hour, indicated as nitrogen dioxide
 - carbon monoxide as the lead substance for evaluating the efficiency of the combustion process, 5 kg/hour
 - carbon monoxide, all other cases, 100 kg/hour
 - fluorine and gaseous inorganic fluorine, 0.5 kg/hour, compounds indicated as hydrofluoride acid
 - gaseous inorganic chlorine compounds, 3 kg/hour, indicated as hydrochloric acid
 - chlorine, 1 kg/hour
 - hydrogen sulfide, 1 kg/hr
- C2.3.21.8 If sulfur dioxide mass concentrations are to be measured continuously, sulfur trioxide mass concentrations shall be determined during calibration and included in the calculation.
- C2.3.21.9 If individual measurements show that the nitrogen dioxide portions in the nitrogen oxide emissions are less than 10 percent, continuous measurements of nitrogen dioxide shall be waived and its portion shall be determined by calculation.
- C2.3.21.10 Facilities whose mass flow emissions of organic substances, indicated as the amount of total carbon, exceed 1 kg/hr for substances of Class I or 10 kg/hr for substances of Class I to Class III; measuring instruments shall be installed at the relevant sources that continuously determine the total amount of carbon.

- C2.3.21.11 Facilities whose emission mass concentrations require permanent monitoring shall be equipped with measuring instruments for the continuous determination of operational parameters (e.g., waste gas temperature, waste gas volume flow, moisture content, pressure, and oxygen content) to allow the proper evaluation and assessment of the continuous measurements.
- C2.3.21.12 The continuous measurements of operational parameters may be waived, if these, from experience, show only slight deviations, which are negligible for emission assessment or may be determined by other methods with sufficient certainty.
- C2.3.21.13 For each calendar day, a daily mean value, related to the daily operating time, shall be formed from the half-hour mean values. Daily mean values shall be kept on file as frequency distribution. A facility or operation is in compliance if the assessment of the frequency distribution for the operating hours of a calendar year shows that established emission standards are not exceeded.
- C2.3.21.14 Measuring instruments that continuously determine and record mass concentrations of air emissions shall be calibrated and tested with respect to their functioning once per year by a qualified person (*Gekennzeichnet Einzelperson*).
- C2.3.21.15 Measuring instruments, other than those that continuously determine and record mass concentrations of air emissions shall be calibrated at least once every 5 years and whenever the facility is substantially altered.
- C2.3.21.16 Operators shall ensure regular maintenance and functional testing of the measuring instruments.

C2.3.22 Measuring and Monitoring Emissions of Combustion Facilities

- C2.3.22.1 The following requirements are applicable for combustion plants for solid, liquid, or mixed-fuel-fired units with a heat output of less than 50 MW and gas-fuel-fired units of less than 100 MW.
- C2.3.22.1.1 Continuous measuring requirements for coal-fired combustion facilities:
- C2.3.22.1.1.1 Individual furnaces with a firing thermal capacity of 5 to 25 MW shall be equipped with measuring instruments, which continuously determine waste gas opacity (e.g., through optical transmission).
 - C2.3.22.1.1.2 Individual furnaces with a firing thermal capacity of more than 25 MW shall be equipped with measuring instruments, which continuously determine particulate mass concentrations.
 - C2.3.22.1.1.3 Individual furnaces with a firing thermal capacity of more than 25 MW shall be equipped with measuring instruments, which continuously determine carbon monoxide mass concentrations.
 - C2.3.22.1.1.4 Continuous measuring of sulfur oxides is not necessary if the operator keeps a record of the sulfur content and the lower calorific value of the

fuel used as well as the quantity and type of added sorbents. These records must be kept for 5 years.

- C2.3.22.1.1.5 For furnaces with a total thermal capacity of 10 MW or more, measurement systems shall be installed for the continuous measurement of the sulfur dioxide mass concentration.

C2.3.22.2 Continuous measuring requirements for oil-fired combustion facilities:

- C2.3.22.2.1 Individual furnaces with a firing thermal capacity of 5 to 25 MW or individual furnaces with a firing thermal capacity of 5 MW or more which exclusively use heating oil according to DIN 51603, Part 1 (December 1981 edition) shall be equipped with measuring instruments which continuously determine waste gas opacity (e.g., through optical transmission). The measurement equipment shall indicate with sufficient precision the attainment of the Bacharach value of 1.
- C2.3.22.2.2 Individual furnaces with a firing thermal capacity of more than 25 MW shall be equipped with measuring instruments, which continuously determine the mass concentration of particle emissions.
- C2.3.22.2.3 Individual furnaces with a firing thermal power of more than 25 MW shall be equipped with measuring instruments, which continuously determine carbon monoxide mass concentrations.
- C2.3.22.2.4 Continuous measurements of sulfur dioxide emissions in the waste gas is not necessary if heating oils with a sulfur mass content of less than 1 percent are used. When using heating oil other than that defined in DIN Standard 51603, Part 1 (December 1981 edition), the operator shall keep a record of the sulfur content of the heating oil used for 5 years.
- C2.3.22.3 Gas-fired combustion facilities with a firing thermal capacity of more than 50 MW shall be equipped with measuring instruments, which continuously determine carbon monoxide mass concentrations.

Table C2.T1 Emission Limits for Steam/Hot Water Generating Units

Fuel Type	1 to 50 MW	10 to 50 MW	50 MW or greater	100 MW or greater
	3.4 to 170 million Btu/hr	34 to 170 million Btu/hr	170 million Btu/hr or greater	341 million BTU/hr or greater
Gaseous, Gaseous - Coal Derived				
PM	N/A	5 mg/m ³	5 mg/m ³	5 mg/m ³
Opacity	N/A	N/A	N/A	N/A
CO	-	0.10 g/m ³	0.10 g/m ³	100 mg/m ³
SO ₂	-	35 mg/m ³ (Gas) 0.10 mg/m ³ (coal derived gas) 5 mg/m ³ (liquid gas)	5 mg/m ³ (Gas) 0.10 mg/m ³ (coal derived gas) 5 mg/m ³ (liquid gas)	35 mg/m ³ (Gas) 0.10 mg/m ³ (coal derived gas) 5 mg/m ³ (liquid gas)
NO _x	-	0.20 g/m ³	0.20 g/m ³	350 mg/m ³
Liquid Fossil Fuel				
PM	80 mg/m ³ mg 50 mg/m ³ (5 MW or greater)	-	50 mg/m ³	-
Opacity ³	20%	20%	20%	20%
CO	0.17 g/m ³	-	175 mg/m ³	-
SO ₂	1.7 g/m ³	-	1700 mg/m ³	1700 mg/m ³
NO _x	0.45 g/m ³ 0.25 g/m ³ (DIN 51603)	-	450 mg/m ³	-
Solid Fossil Fuel¹				
PM	0.15 mg/m ³ 50 mg/m ³ (5 MW or greater)	-	50 mg/m ³	-
Opacity ³	20%	20%	20%	20%
CO	0.25 g/m ³	-	250 mg/m ³	-
SO ₂	2.0 g/m ³ 0.40 g/m ³ (fluidized bed)	-	400 mg/m ³ 650 mg/m ³ (coal with extremely high or inconsistent sulfur content)	2000 mg/m ³ 400 mg/m ³ (fluidized bed)
NO _x	0.50 g/m ³ 0.30 g/m ³ (fluidized bed)	-	800 mg/m ³ 1800 mg/m ³ (for particulate combustion with wet ash removal)	-
Other Solid Fuels²				
Emission values for incinerators apply				

mg/m³ or g/m³ units refer to mass concentration of substance in waste gas .

¹ Coal, briquettes .

² Wood, including coated and painted wood, except wood treated with wood preservative and coatings containing halogenated hydrocarbons.

³ Opacity standards do not apply to units < 30 million Btu/hr. The 20% standard applies to the average opacity over a 6-minute period. A 30% opacity value is allowed for one 6-minute period per hour.

Table C2.T2 Mass Concentration Limits for Incinerators

Waste Gas Component	Mass Concentration		
	Daily Mean Value	0.5 Hours Mean Value	Sampling Period Mean Value
total dust	10 mg/m ³	30 mg/m ³	-
total carbon	10 mg/m ³	20 mg/m ³	-
carbon monoxide	50 mg/m ³	100 mg/m ³	150 mg/m ³ within 24 hours and at a minimum of 90 percent of all measurements
inorganic gaseous chlorine compounds (indicated as hydrochloric acid)	10 mg/m ³	60 mg/m ³	-
inorganic gaseous fluoride compounds (indicated as hydrogen fluoride)	1 mg/m ³	4 mg/m ³	-
sulfur dioxide and sulfur trioxide, indicated as sulfur dioxide	50 mg/m ³	0.20 g/m ³	-
nitrogen monoxide and nitrogen dioxide, indicated as nitrogen dioxide	0.20 g/m ³	0.40 g/m ³	-
Mercury and its compounds, indicated as Hg	0.03 mg/m ³	0.05 mg/m ³	-

Table C2.T3 Mass concentration Limits for Incinerators (Metals, Dioxins, and Furans)

Waste Gas Components	Mass Concentration Individually and of Class as Sampling Period Mean Value
Cadmium and its compounds, indicated as Cd	0.05 mg/m ³
Arsenic and its compounds, indicated as As Antimony and its compounds, indicated as Sb Lead and its compounds, indicated as Pb Chromium and its compounds, indicated as Cr Cobalt and its compounds indicated as Co Copper and its compounds, indicated as Cu Manganese and its compounds, indicated as Mn Nickel and its compounds, indicated as Ni Vanadium and its compounds, indicated as V Tin and its compounds, indicated as Sn	0.5 mg/m ³
Dioxins and furans	0.1 ng/m ³

Table C2.T4 Total Dust Emission Limits

Relevant Mass Flow	Mass Concentration
up to 0.5 kg/h	0.15 g/m ³
0.5 kg/hr or more	50 mg/m ³

Table C2.T5 Inorganic Dusty Material Emission Limits

Class	Relevant Mass Flow	Maximum Mass Concentration
Class I - Cadmium and its compounds, indicated as Cd - Mercury and its compounds, indicated as Hg - Thallium and its compounds, indicated as Tl	1 g/hr or more	0.2 mg/m ³
Class II - Arsenic and its compounds, indicated as As - Cobalt and its compounds indicated as Co - Nickel and its compounds, indicated as Ni - Selenium and its compounds, indicated as Se - Tellurium and its compounds, indicated as Te	5 g/hr or more	1 mg/m ³
Class III - Antimony and its compounds, indicated as Sb - Lead and its compounds, indicated as Pb - Chromium and its compounds, indicated as Cr - Cyanides easily soluble (e.g. NaCN), indicated as CN - Fluorides easily soluble (e.g. NaF), indicated as F - Copper and its compounds, indicated as Cu - Manganese and its compounds, indicated as Mn - Platinum and its compounds, indicated as Pt - Palladium and its compounds, indicated as Pd - Rhodium and its compounds, indicated as Rh - Vanadium and its compounds, indicated as V - Tin and its compounds, indicated as Sn	25 g/hr or more	5 mg/m ³

Note: Inorganic dusty substances of the classes identified must not exceed the stated concentrations in the waste gas individually and by class

Table C2.T6 Vaporous and Gaseous Inorganic Substance Emission Limits

Class	Relevant Mass Flow of Each	Maximum Mass Concentration
Class I - Arsine - Cyanogen chloride - Phosgene - Hydrogen phosphide	10 g/hr or more	1 mg/m ³
Class II - Bromine and its vaporous or gaseous compounds, indicated as hydrogen bromide - Chlorine - Hydrocyanic acid - Fluorine and its vaporous or gaseous compounds, indicated as hydrofluoric acid - Hydrogen sulfide	50 g/hr or more	5 mg/m ³
Class III - Vaporous or gaseous inorganic chlorine compounds, if not in Class I, indicated as hydrochloric acid	0.3 kg/hr or more	30 mg/m ³
Class IV - Sulfur oxide (sulfur dioxide and sulfur trioxide), indicated as sulfur dioxide - Nitrogen oxide (nitrogen monoxide and nitrogen dioxide), indicated as nitrogen dioxide	5 kg/hr or more	0.50 g/m ³

Table C2.T7 Classification of Organic Substances

Substance	Empirical formula	Class
Acetaldehyde	C ₂ H ₄ O	I
Acetone	C ₂ H ₆ O	III
Acrolein	cf: 2-Propenal	-
Acrylic acid	C ₃ H ₄ O ₂	I
Acrylic-acid ethyl ester	cf: Ethyl acrylate	-
Acrylic-acid methyl ester	cf: Methyl acrylate	-
Alkyl alcohols	-	III
Alkyl lead compounds	-	I
Formic acid	CH ₂ O ₂	-
Formic-acid methyl ester	cf: methyl formate	-
Aniline	C ₆ H ₇ N	I
Benzyl chloride	cf: Chlorotoluene	-
Biphenyl	C ₁₂ H ₁₀	I
2-Butanone	C ₄ H ₈ O	III
2-Butoxyethanol	C ₆ H ₁₄ O ₂	II
Butyl acetate	C ₆ H ₁₂ O ₂	III
Butylglycol	cf: 2-Butoxyethanol	-
Butyric aldehyde	C ₄ H ₈ O	II
Chloroacetaldehyde	C ₂ H ₃ ClO	I
Chlorobenzene	C ₆ H ₅ Cl	II
2-Chloro-1,3-butadiene	C ₄ H ₅ Cl	II
Chloroacetic acid	C ₂ H ₃ ClO ₂	I
Chloroethane	C ₂ H ₅ Cl	III
Chloromethane	CH ₃ Cl	I
Chloroform	cf: Trichloromethane	-
2-Chloroprene	cf: 2-Chloro-1,3-butadiene	-
2-Chloropropane	C ₃ H ₇ Cl	II
-Chlorotoluene	C ₇ H ₇ Cl	I
Cumene	cf: Isopropylbenzene	
Cyclohexanone	C ₆ H ₁₀ O	II
Diacetone alcohol	cf: 4-Hydroxy-4-methyl-2-pentanone	-
Dibutylether	C ₈ H ₁₈ O	III
1,2-Dichlorobenzene	C ₆ H ₄ Cl ₂	I
1,4-Dichlorobenzene	C ₆ H ₄ Cl ₂	II
Dichlorodifluoromethane	CCl ₂ F ₂	III
1,1-Dichloroethane	C ₂ H ₄ Cl ₂	II
1,2-Dichloroethane	C ₂ H ₄ Cl ₂	I
1,1-Dichloroethylene	C ₂ H ₂ Cl ₂	I
1,2-Dichloroethylene	C ₂ H ₂ Cl ₂	III
Dichloromethane	CH ₂ Cl ₂	III

Substance	Empirical formula	Class
Dichlorophenole	$C_6H_4Cl_2O$	I
Diethanolamine	cf: 2,2'-Iminodiethanol	-
Diethylamine	$C_4H_{11}N$	I
Diethylether	$C_4H_{10}O$	III
Di-(2-ethylhexyl)-phtalate	$C_{24}H_{38}O_4$	II
Diisopropyl ether	$C_6H_{14}O$	III
Diisopropylketone	cf: 2,6-Dimethylheptane-4-on	-
Dimethylamine	C_2H_7N	I
Dimethyl ether	C_2H_6O	III
N,N-Dimethyl formamide	C_3H_7NO	II
2,6-Dimethylheptane-4-on	$C_7H_{14}O$	II
Diocylphtalate	cf: Di-(2-ethylhexyl)-phtalate	-
1,4-Dioxan	$C_4H_8O_2$	I
Diphenyl	cf: Biphenyl	-
Acetic ester	cf: Ethyl acetate	-
Acetic acid	$C_2H_4O_2$	II
Acetic-acid butyl ester	cf: Butyl acetate	-
Acetic-acid ethyl ester	cf: Ethyl acetate	-
Acetic-acid methyl ester	cf: Methyl acetate	-
Acetic-acid vinyl ester	cf: Vinyl acetate	-
Ethanol	cf: Alkyl alcohols	-
Ether	cf: Diethyl ether	-
2-Ethoxyethanol	$C_4H_{10}O_2$	II
Ethyl acetate	$C_4H_8O_2$	III
Ethylacrylate	$C_5H_8O_2$	I
Ethylamine	C_2H_7N	I
Ethylbenzene	C_8H_{10}	II
Ethyl chloride	cf: Chloroethane-Chlorethan	-
Ethylene glycol	$C_2H_6O_2$	III
Ethylene glycol methyl ether	cf: 2-Methoxyethanol	-
Ethylglycol	cf: 2-Ethoxyethanol	-
Ethylmethylketone	cf: 2-Butanone	-
Formaldehyde	CH_2O	I
2-Furylaldehyde	$C_5H_4O_2$	I
Furfural, Furfurol	cf: 2-Furylaldehyde	-
Fufuryl alcohol	$C_5H_6O_2$	II
Glykok	cf: Ethylene glycol	-
Respirable wood particles		I
4-Hydroxy-4-Methyl-2-pentanone	$C_6H_{12}O_2$	III
2,2'-Iminodiethanol	$C_4H_{11}NO_2$	II
Isobutylmethylketone	cf: 4-Methyl-2-pentanone	-
Isopropenylbenzene	C_9H_{10}	II

Substance	Empirical formula	Class
Isopropylbenzene	C ₉ H ₁₂	II
Carbon disulfide	CS ₂	II
Cresols	C ₇ H ₈ O	I
Maleic anhydride	C ₄ H ₂ O ₃	I
Mercaptans	cf: Thioalcohols	-
Methyl metacrylate	cf: Methylmetacrylate	-
Methanol	cf: Alkyl alcohols	-
2-Methoxyethanol	C ₃ H ₈ O ₂	II
Methyl acetate	C ₃ H ₆ O ₂	II
Methyl acrylate	C ₄ H ₆ O ₂	I
Methylamine	CH ₅ N	I
Methyl benzoate	C ₈ H ₈ O ₂	III
Methyl chloride	cf: Chloromethane	-
Methylchloroform	cf: 1,1,1-Trichlorethane	-
Methylcyclohexanons	C ₇ H ₁₂ O	II
Methylen dichloride	cf: Dichloromethane	-
Methylethylketone	cf: 2-Butanone	-
Methyl formate	C ₂ H ₄ O ₂	II
Methyl glycol	cf: 2-Methoxyethanol	-
Methyl isobutyl ketone	cf: 4-Methyl-2-pentanone	-
Methyl methacrylate	C ₅ H ₈ O ₂	II
4-Methyl-2-pentanone	C ₆ H ₁₂ O	III
4-Methyl-m-phenylenediiso-cyanate	C ₉ H ₆ N ₂ O ₂	I
N-Methylpyrrolidone	C ₅ H ₉ NO	III
Naphthaline	C ₁₀ H ₈	II
Nitrobenzene	C ₆ H ₅ NO ₂	I
Nitrocresols	C ₇ H ₇ NO ₃	I
Nitrophenols	C ₆ H ₅ NO ₃	I
Nitrotoluene	C ₇ H ₇ NO ₂	I
Olefin hydrocarbons (except 1,3-Butadiene)		III
Paraffin hydrocarbons (except Methane)		III
Perchloroethylene	cf: Tetrachloroethylene	-
Phenon	C ₆ H ₆ O	I
Pinenes	C ₁₀ H ₁₆	III
2-Propenal	C ₃ H ₄ O	I
Propionaldehyde	C ₃ H ₆ O	II
Propionic acid	C ₃ H ₆ O ₂	II
Pyridine	C ₅ H ₅ N	I
Sulfide of carbon	cf: Carbon disulfide	-
Styrene	C ₈ H ₈	II
1,1,2,2-Tetrachlorethane	C ₂ H ₂ Cl ₄	I
Tetrachlorethylene	C ₂ Cl ₄	II

Substance	Empirical formula	Class
Carbon tetrachloride	cf: Tetrachloromethane	-
Tetrachloromethane	CCl_4	I
Tetrahydrofuran	$\text{C}_4\text{H}_8\text{O}$	II
Thioalcohols		I
Thioether		I
o-Toluidine	$\text{C}_7\text{H}_9\text{N}$	I
Toluene	C_7H_8	II
Toluylene-2,4-diisocyanate	cf: 4-Methyl-m-phenylenediisocyanate	-
1,1,1-Trichloroethane	$\text{C}_2\text{H}_3\text{Cl}_3$	II
1,1,2-Trichloroethane	$\text{C}_2\text{H}_3\text{Cl}_3$	I
Trichlorethylene	C_2HCl_3	II
Trichlormethane	CHCl_3	I
Trichlorophenols	$\text{C}_6\text{H}_3\text{OCl}_3$	I
Triethylamine	$\text{C}_6\text{H}_{15}\text{N}$	I
Trichlorofluoromethane	CCl_3F	III
Trimethylbenzenes	C_9H_{12}	II
Vinyl acetate	$\text{C}_4\text{H}_6\text{O}_2$	II
Xylenols (except 2,4-Xylenol)	$\text{C}_8\text{H}_{10}\text{O}$	I
2,4-Xylenol	$\text{C}_8\text{H}_{10}\text{O}$	II
Xylenes	C_8H_{10}	II

Table C2.T8 Organic Substance Emission Limits

Class	Relevant Mass Flow	Mass Concentration Limit
Class I substances	0.1 kg/hr or more	20 mg/m ³
Class II substances	2 kg/hr or more	0.10 g/m ³
Class III substances	3 kg/hr or more	0.15 g/m ³

Table C2.T9 Classes of Carcinogenic Substances

<p>Class I substances:</p> <ul style="list-style-type: none"> - Asbestos (chrysotile, crocidolite, amosite, anthophyllite, actinolite, tremolite) as fine dust - Benzo(a)pyrene - Beryllium and its compounds in respirable form, indicated as beryllium - Dibenzo(a,h)anthracene - 2-Naphthalamine
<p>Class II substances:</p> <ul style="list-style-type: none"> - Arsenic trioxide and arsenic pentoxide, arsenious acid and its salts, arsenic acids and its salts (in respirable form), indicated as arsenic - Chromium (VI) compounds in respirable form (e.g., calcium chromate, chromium (III)chromate, strontium chromate, and zinc chromate, indicated as chromium - Cobalt in the form of respirable dusts/aerosols of cobalt metal and cobalt salts of low solubility, indicated as cobalt - Dichlorobenzidine - Dimethyl sulfate - Ethyleneimine - Nickel in the form of respirable dusts/aerosols of nickel metal, nickel sulfide and pyritiferous ores, nickel oxide and nickel carbonate, nickel tetracarbonyl, indicated as nickel
<p>Class III substances:</p> <ul style="list-style-type: none"> - Acrylonitrile - Benzene - 1,3-Butadiene - 1-Chloro-2,3-epoxypropane (epichlorohydrin) - 1,2-Dibromomethane - 1,2-Epoxypropane - Ethylene oxide - Hydrazine - Vinyl chloride

Table C2.T10 Ozone Depleting Substances (ODSs)

Molecular Formula	Common Name	CAS Number	Chemical Name
Chlorofluorocarbons (CFCs)			
CFCl_3	CFC – 11	75-69-4	Trichlorofluoromethane ^R
CF_2Cl_2	CFC – 12	75-71-8	Dichlorodifluoromethane ^R
$\text{C}_2\text{F}_3\text{Cl}_3$	CFC – 113	76-13-1	Trichlorotrifluoroethane ^R
$\text{C}_2\text{F}_4\text{Cl}_2$	CFC – 114	76-14-2	Dichlorotetrafluoroethane ^R
$\text{C}_2\text{F}_5\text{Cl}$	CFC – 115	76-15-3	Chloropentafluoroethane ^R
Other Fully Halogenated Chlorofluorocarbons			
CF_3Cl	CFC – 13	75-72-9	Chlorotrifluoromethane ^R
C_2FCl_5	CFC – 111	354-56-3	Pentachlorofluoroethane
$\text{C}_2\text{F}_2\text{Cl}_4$	CFC – 112	76-12-0	Tetrachlorodifluoroethane ^R
C_3FCl_7	CFC – 211	422-78-6	Heptachlorofluoropropane
$\text{C}_3\text{F}_2\text{Cl}_6$	CFC – 212	3182-26-1	Hexachlorodifluoropropane
$\text{C}_3\text{F}_3\text{Cl}_5$	CFC – 213	2354-06-5	Pentachlorotrifluoropropane
$\text{C}_3\text{F}_4\text{Cl}_4$	CFC – 214	29255-31-0	Tetrachlorotetrafluoropropane
$\text{C}_3\text{F}_5\text{Cl}_3$	CFC – 215	4259-43-2	Trichloropentafluoropropane
$\text{C}_3\text{F}_6\text{Cl}_2$	CFC – 216	661-97-2	Dichlorohexafluoropropane
$\text{C}_3\text{F}_7\text{Cl}$	CFC – 217	422-86-6	Chloroheptafluoropropane
$\text{CF}_2\text{Cl}_2 \bullet \text{C}_2\text{F}_2\text{H}_4$	CFC – 500	56275-41-3	Dichlorodifluoromethane • Difluoroethane
$\text{CHF}_2\text{Cl} \bullet \text{C}_2\text{F}_5\text{Cl}$	CFC – 502	74-45-6 and 76-15-3	Chlorodifluoromethane • Chloropentafluoroethane
$\text{CF}_3\text{Cl} \bullet \text{CHF}_3$	CFC – 503	75-72-9 and 75-46-7	Chlorotrifluoromethane • Trifluoromethane
Halons			
CF_2BrCl	Halon – 1211	353-59-3	Bromochlorodifluoromethane ^R
CF_3Br	Halon – 1301	75-63-8	Bromotrifluoromethane ^R
$\text{C}_2\text{F}_4\text{Br}_2$	Halon – 2402	124-73-2	Dibromotetrafluoroethane ^R
Carbon Tetrachloride			
CCl_4	Carbon Tetrachloride	56-23-5	Carbon Tetrachloride ^R

Molecular Formula	Common Name	CAS Number	Chemical Name
1,1,1-trichloroethane			
C ₂ H ₃ Cl ₃	Methyl Chloroform	71-55-6	1,1,1-trichloroethane ^R
Methyl Bromide			
CH ₃ Br	Methyl Bromide	74-83-9	Methyl Bromide
Hydrobromofluorocarbons			
CHBr ₂	N/A	-	Dibromofluoromethane
CHF ₂ Br	HBFC-22B1	-	Bromodifluoromethane
CH ₂ FBr	N/A	-	Bromofluoromethane
C ₂ HBr ₄	N/A	-	Tetrabromofluoroethane
C ₂ HF ₂ Br ₃	N/A	-	Tribromodifluoroethane
C ₂ HF ₃ Br ₂	N/A	-	Dibromotrifluoroethane
C ₂ HF ₄ Br	N/A	-	Bromotetrafluoroethane
C ₂ H ₂ FBr ₃	N/A	-	Tribromofluoroethane
C ₂ H ₂ F ₂ Br ₂	N/A	-	Dibromodifluoroethane
C ₂ H ₂ F ₃ Br	N/A	-	Bromotrifluoroethane
C ₂ H ₃ FBr ₂	N/A	-	Dibromofluoroethane
C ₂ H ₃ F ₂ Br	N/A	-	Bromodifluoroethane
C ₂ H ₄ FBr	N/A	-	Bromofluoroethane
C ₃ HBr ₆	N/A	-	Hexabromofluoropropane
C ₃ HF ₂ Br ₅	N/A	-	Pentabromodifluoropropane
C ₃ HF ₃ Br ₄	N/A	-	Tetrabromotrifluoropropane
C ₃ HF ₄ Br ₃	N/A	-	Tribromotetrafluoropropane
C ₃ HF ₅ Br ₂	N/A	-	Dibromopentafluoropropane
C ₃ HF ₆ Br	N/A	-	Bromohexafluoropropane
C ₃ H ₂ FBr ₅	N/A	-	Pentabromofluoropropane
C ₃ H ₂ F ₂ Br ₄	N/A	-	Tetrabromodifluoropropane
C ₃ H ₂ F ₃ Br ₃	N/A	-	Tribromotrifluoropropane

Molecular Formula	Common Name	CAS Number	Chemical Name
C ₃ H ₂ F ₄ Br ₂	N/A	-	Dibromotetrafluoropropane
C ₃ H ₂ F ₅ Br	N/A	-	Bromopentafluoropropane
C ₃ H ₃ FBr ₄	N/A	-	Tetrabromofluoropropane
C ₃ H ₃ F ₂ Br ₃	N/A	-	Tribromodifluoropropane
C ₃ H ₃ F ₃ Br ₂	N/A	-	Dibromotrifluoropropane
C ₃ H ₃ F ₄ Br	N/A	-	Bromotetrafluoropropane
C ₃ H ₄ FBr ₃	N/A	-	Tribromofluoropropane
C ₃ H ₄ F ₂ Br ₂	N/A	-	Dibromodifluoropropane
C ₃ H ₄ F ₃ Br	N/A	-	Bromotrifluoropropane
C ₃ H ₅ FBr ₂	N/A	-	Dibromofluoropropane
C ₃ H ₅ F ₂ Br	N/A	-	Bromodifluoropropane
C ₃ H ₅ FBr	N/A	-	Bromofluoropropane
Hydrochlorofluorocarbons (HCFCs)			
CHFC ₂	HCFC – 21	-	Dichlorofluoromethane
CHF ₂ Cl	HCFC – 22	-	Chlorodifluoromethane ^R
CH ₂ FCl	HCFC – 31	-	Chlorofluoromethane
C ₂ HFCl ₄	HCFC – 121	-	Tetrachlorofluoroethane
C ₂ HF ₂ Cl ₃	HCFC – 122	-	Trichlorodifluoroethane
C ₂ HF ₃ Cl ₂	HCFC – 123	-	Dichlorotrifluoroethane
C ₂ HF ₄ Cl	HCFC – 124	-	Chlorotetrafluoroethane
C ₂ H ₂ FC ₃	HCFC – 131	-	Trichlorofluoroethane
C ₂ H ₂ F ₂ Cl ₂	HCFC – 132	-	Dichlorodifluoroethane
C ₂ H ₂ F ₃ Cl	HCFC – 133	-	Chlorotrifluoroethane
C ₂ H ₃ FC ₂	HCFC – 141	-	Dichlorofluoroethane
CH ₃ CFCl ₂	HCFC – 141b	-	1,1-dichloro-1-fluoroethane
C ₂ H ₃ F ₂ Cl	HCFC – 142	-	Chlorodifluoroethane
CH ₃ CF ₂ Cl	HCFC – 142b	-	1-chloro-1,1-difluoroethane

Molecular Formula	Common Name	CAS Number	Chemical Name
C ₂ H ₄ FCI	HCFC – 151	-	Chlorofluoroethane
C ₃ HFC ₆	HCFC – 221	-	Hexachlorofluoropropane
C ₃ HF ₂ Cl ₅	HCFC – 222	-	Pentachlorodifluoropropane
C ₃ HF ₃ Cl ₄	HCFC – 223	-	Tetrachlorotrifluoropropane
C ₃ HF ₄ Cl ₃	HCFC – 224	-	Trichlorotetrafluoropropane
C ₃ HF ₅ Cl ₂	HCFC – 225	-	Dichloropentafluoropropane
CF ₃ CF ₂ CHCl ₂	HCFC – 225ca	-	1,1-dichloro-2,2,3,3,3-pentafluoropropane
CF ₂ ClCF ₂ CHClF	HCFC – 225cb	-	1,3-dichloro-1,2,2,3,3-pentafluoropropane
C ₃ HF ₆ Cl	HCFC – 226	-	Chlorohexafluoropropane
C ₃ H ₂ FCI ₅	HCFC – 231	-	Pentachlorofluoropropane
C ₃ H ₂ F ₂ Cl ₄	HCFC – 232	-	Tetrachlorodifluoropropane
C ₃ H ₂ F ₃ Cl ₃	HCFC – 233	-	Trichlorotrifluoropropane
C ₃ H ₂ F ₄ Cl ₂	HCFC – 234	-	Dichlorotetrafluoropropane
C ₃ H ₂ F ₅ Cl	HCFC – 235	-	Chloropentafluoropropane
C ₃ H ₃ FCI ₄	HCFC – 241	-	Tetrachlorofluoropropane
C ₃ H ₃ F ₂ Cl ₃	HCFC – 242	-	Trichlorodifluoropropane
C ₃ H ₃ F ₃ Cl ₂	HCFC – 243	-	Dichlorotrifluoropropane
C ₃ H ₃ F ₄ Cl	HCFC – 244	-	Chlorotetrafluoropropane
C ₃ H ₄ FCI ₃	HCFC – 251	-	Trichlorofluoropropane
C ₃ H ₄ F ₂ Cl ₂	HCFC – 252	-	Dichlorodifluoropropane
C ₃ H ₄ F ₃ Cl	HCFC – 253	-	Chlorotrifluoropropane
C ₃ H ₅ FCI ₂	HCFC – 261	-	Dichlorofluoropropane
C ₃ H ₅ F ₂ Cl	HCFC – 262	-	Chlorodifluoropropane
C ₃ H ₆ FCI	HCFC – 271	-	Chlorofluoropropane

^R These ODSs are designated as restricted use ODSs in Germany.

Table C2.T11 Carcinogenic Substance Emission Limits

Class	Relevant Mass Flow	Mass Concentration
Class I substances	0.5 g/hr or more	0.1 mg/m ³
Class II substances	5 g/hr or more	1 mg/m ³
Class III substances	25 g/hr or more	5 mg/m ³

Table C2.T12 Small Heating Units

Allowed Fuels (solid, liquid, and gaseous)	Rated Heat Output
Coals, natural wood, heating oil (except extra light heating oil) Coated and painted wood (except wood treated with wood preservative and coatings containing halogenated hydrocarbons)	up to 1 megawatt
Extra light heating oil	up to 5 megawatts
Gas from a public gas supplier Natural gas Liquid gas Hydrogen	up to 10 megawatts

Table C2.T13 Solid Fuel Fired Heating Plant Emission Limits

Fuel	Rated Heat Output in kW	Mass Concentration of Dust	Mass Concentration of Carbon Monoxide	Based on Oxygen in the Flue Gas
Coal	> 15	0.15 g/m ³	-	3 percent
Natural wood	> 15 to 50	0.15 g/m ³	4 g/m ³	13 percent
	> 50 to 150		2 g/m ³	
	> 150 to 500		1 g/m ³	
	> 500		0.5 g/m ³	
Other wood	> 50 to 100	0.15 g/m ³	0.8 g/m ³	13 percent
	> 100 to 500	0.15 g/m ³	0.5 g/m ³	
	> 500	0.15 g/m ³	0.3 g/m ³	

Table C2.T14 Allowable Energy Loss - Installation After 31 December 1997

Rated Heat Output	Allowable Energy Loss (%) ¹
> 4 to 25 kilowatt	11
> 25 to 50 kilowatt	10
> 50 kilowatt	9

¹ Percentage of the heating value of fuel.

Table C2.T15 Allowable Energy Loss - Installation Before 31 December 1997

Rated Heat Output	Allowable Energy Loss (%) ¹	
	Installed Between 1 January 1983 and 31 December 1997	Installed Before 1 January 1983
> 4 to 25 kilowatt	14	15
> 25 to 50 kilowatt	13	14
> 50 kilowatt	12	13

¹ Percentage of the heating value of fuel.

Table C2.T16 Large Heating Plants

Allowed Fuel (Solid, Liquid, and Gaseous)	Rated Heat Output
Coals, natural wood, heating oil (except extra light heating oil) Coated and painted wood (except wood treated with wood preservative and coatings containing halogenated hydrocarbons)	1 megawatt or more
Extra light heating oil	5 megawatts or more
Gas from a public gas supplier Natural Gas Liquid Gas Hydrogen	10 megawatts or more

Table C2.T17 Heating Plant Emission Values, 1 to 50 MW Heat Output

Waste Gas Component	Mass Concentration Emission Value ¹	Rated Heat Output in Megawatts	Type of Furnace
dust	0.15 g/m ³	1 to 5	all
	50 mg/m ³	5 or more	all
carbon monoxide	0.25 g/m ³	1 to 50	all
	0.25 g/m ³	1 to 2.5	solo furnace only at nominal power level
organic substances indicated as total carbon	50 mg/m ³	1 to 50	only wood-fired
sulfur dioxide and sulfur trioxide, indicated as sulfur dioxide	2.0 g/m ³	1 to 10	all except fluidized bed combustion and brown coal firing
	1.0 g/m ³	1 to 50	all brown coal firing except fluidized bed combustion furnace
	0.40 g/m ³	1 to 50	fluidized bed combustion
nitrogen monoxide and nitrogen dioxide, indicated as nitrogen dioxide	0.50 g/m ³	1 to 50	all
	0.40 g/m ³	1 to 50	new grate firing except hard coal firing up to 10 megawatts and wood firing
		20 to 50	new dust firing except wood firing
	0.30 g/m ³	20 to 50	stationary fluidized bed combustion
	0.30 g/m ³	1 to 50	circulating fluidized bed combustion

¹ The emission values are based on an oxygen content in the flue gas of 7 percent (7%) when firing coal and on 11 percent (11%) when firing wood.

Table C2.T18 Internal Combustion Engine Emission Limits

Engine Type	Nitrogen Limit (measured as NO ₂)
Internal combustion engine with a firing thermal power less than 3 MW	4.0 mg/m ³
Internal combustion engine with a firing thermal power greater than or equal to 3 MW	2.0 mg/m ³
Four stroke engine	0.50 mg/m ³
Two stroke engine	0.80 mg/m ³

Table C2.T19 Gas Turbine Emission Limits

Parameter	Emission Limit (units with a mass flow less than 60,000 m ³ /hr)	Emission Limit (units with a mass flow greater than or equal to 60,000 m ³ /hr)
Opacity	4 (Bacharach value)	2 (Bacharach value) ¹
Carbon monoxide ²	100 mg/m ³	100 mg/m ³
Nitrogen oxides (measured as NO ₂) ³	0.35 g/m ³	0.30 g/m ³

¹ During continuous operation. Emission limit of 3 (Bacharach value) during start up.

² During continuous operation.

³ New gas-fired units below 100 MW shall not exceed 0.15 g/m³, if possible. New oil-fired units (oil extra light) shall not exceed 0.20 g/m³, if possible.

Table C2.T20 Critical Uses for Halon

<p><u>Uses of Halon 1301:</u></p> <p>In aircraft for the protection of crew compartments, engine nacelles, cargo bays and dry bays,</p> <p>In military land vehicles and naval vessels for the protection of spaces occupied by personnel and engine compartments,</p> <p>For the making inert of occupied spaces where flammable liquid and/or gas release could occur in the military and oil, gas and petrochemical sector, and in existing cargo ships,</p> <p>For the making inert of existing manned communication and command centers of the armed forces or others, essential for national security,</p> <p>For the making inert of spaces where there may be a risk of dispersion of radioactive matter, and</p> <p>In the Channel Tunnel and associated installations and rolling stock.</p>
<p><u>Uses of Halon 1211:</u></p> <p>In hand-held fire extinguishers and fixed extinguisher equipment for engines for use on board aircraft,</p> <p>In aircraft for the protection of crew compartments, engine nacelles, cargo bays and dry bays,</p> <p>In fire extinguishers essential to personal safety used for initial extinguishing by fire brigades, and</p> <p>In military and police fire extinguishers for use on persons.</p>